【CLAIMS】

【Claim 1】

An apparatus for manufacturing ultra-fine particles using corona discharge, comprising:

a reaction gas supplying means for supplying reaction gas;

at least one nozzle connected to the reaction gas supplying means, injecting the reaction gas flowing therein, and producing a large number of ultra-fine particles by corona discharge of the injected reaction gas;

a power supplying means connected to the nozzle for applying a voltage causing the corona discharge thereto; and

a collecting means spaced from the nozzle and collecting the ultra-fine particles produced by the corona discharge of the nozzle.

【Claim 2】

The apparatus as claimed in claim 1, further comprising a duct enclosing the nozzle to cause a passage to be formed between the nozzle and the duct, and a sheath gas supplying means for supplying sheath gas to the passage of the duct in order to form a gas curtain that leads flow of the ultra-fine particles between the nozzle and the collecting means.

【Claim 3】

The apparatus as claimed in claim 2, further comprising a first variable resistor dropping a high voltage applied from the power supplying means to a low voltage and applying the low voltage to the duct, and a second variable resistor connected to the first variable resistor and grounded.

【Claim 4】

The apparatus as claimed in claim 2, wherein a tip of the nozzle extrudes out of the duct, the apparatus further comprising a delivering means for delivering the collecting means.

【Claim 5】

An apparatus for manufacturing ultra-fine particles using corona discharge, comprising:

a first reaction gas supplying means for supplying first reaction gas;

at least a first nozzle connected to the first reaction gas supplying means, injecting the first reaction gas flowing therein, and producing a large number of first ultra-fine particles by corona discharge of the injected first reaction gas;

a first power supplying means connected to the first nozzle for applying a first voltage causing corona discharge thereto;

a second reaction gas supplying means for supplying second reaction gas different from the first reaction gas;

at least a second nozzle faced to and spaced from the first nozzle, connected to the second reaction gas supplying means, injecting the second reaction gas flowing therein, and producing a large number of second ultra-fine particles by corona discharge of the injected second reaction gas; and

a second power supplying means connected to the second nozzle for applying a second voltage causing corona discharge thereto in order for the first ultra-fine particles and the second ultra-fine particles to adhere to each other between the first nozzle and the second nozzle.

【Claim 6】

An apparatus for manufacturing ultra-fine particles using corona discharge, comprising:

a first reaction gas supplying means for supplying first reaction gas;

at least one nozzle connected to the first reaction gas supplying means, injecting the first reaction gas flowing therein, and producing a large number of first ultra-fine particles by corona discharge of the injected first reaction gas;

a power supplying means connected to the nozzle for applying a high voltage causing corona discharge thereto;

a duct enclosing the nozzle to cause a passage to be formed between the nozzle and the duct;

a second reaction gas supplying means for supplying the passage of the duct with second reaction gas different from the first reaction gas;

a heating means installed on an outer surface of the duct and providing heat energy to the second reaction gas in order to coat the first ultra-fine particles with a large number of second ultra-fine particles, the second ultra-fine particles being obtained by thermochemical reaction of the second reaction gas; and

a collecting means spaced from the duct and collecting the first ultra-fine particles coated with the second ultra-fine particles.

【Claim 7】

The apparatus as claimed in claim 6, wherein the nozzle is entirely accommodated in the passage of the duct.

【Claim 8】

An apparatus for manufacturing ultra-fine particles using corona discharge, comprising:

a first reaction gas supplying means for supplying first reaction gas;

at least a first nozzle connected to the first reaction gas supplying means, injecting the first reaction gas flowing therein, and producing a large number of first ultra-fine particles by corona discharge of the injected first reaction gas;

a first power supplying means connected to the first nozzle for applying a first high voltage causing corona discharge thereto;

a first duct enclosing the nozzle to cause a passage to be formed between the first nozzle and the first duct;

a second reaction gas supplying means for supplying the passage of the first duct with second reaction gas different from the first reaction gas;

at least a second nozzle installed at a distal end of the first duct, injecting the first ultra-fine particles and the second reaction gas flowing therein, producing a large number

of second ultra-fine particles by corona discharge of the injected second reaction gas, and coating the first ultra-fine particles with the second ultra-fine particles;

a second power supplying means connected to the second nozzle for applying a second high voltage causing corona discharge thereto; and

a collecting means spaced from the second nozzle and collecting the first ultra-fine particles coated with the second ultra-fine particles.

【Claim 9】

The apparatus as claimed in claim 8, further comprising a second duct enclosing the first duct and the second nozzle to cause a passage to be formed between the first duct and the second duct and between the second nozzle and the second duct, and a sheath gas supplying means for supplying sheath gas to the passage of the second duct to form a gas curtain that leads flow of the first ultra-fine particles coated with the second ultra-fine particles between the second nozzle and the collecting means.

【Claim 10】

The apparatus as claimed in claim 9, further comprising a first variable resistor dropping the first high voltage applied from the first power supplying means to a first low voltage and applying the first low voltage to the first duct, a second variable resistor connected to the first variable resistor and grounded, a third variable resistor dropping the second high voltage applied from the second power supplying means to a second low voltage and applying the second low voltage to the second duct, and a fourth variable resistor connected to the third variable resistor and grounded.

【Claim 11】

The apparatus as claimed in claim 9, wherein a tip of the second nozzle extrudes out of the second duct, the apparatus further comprising a delivering means for delivering the collecting means.

【Claim 12】

A method for manufacturing ultra-fine particles using corona discharge, comprising steps of:

generating corona discharge by allowing a power supplying means to apply a high voltage to a nozzle;

supplying reaction gas to the nozzle by a reaction gas supplying means;

producing a large number of ultra-fine particles by injecting the reaction gas into a corona discharge region of the nozzle; and

collecting the ultra-fine particles by a collecting means, the ultra-fine particles passing through the corona discharge region of the nozzle.

【Claim 13】

The method as claimed in claim 12, wherein the high voltage is applied in the form of a pulse.

【Claim 14】

The method as claimed in claim 12, further comprising the step of forming a gas curtain of sheath gas in order to lead flow of the ultra-fine particles between the nozzle and the collecting means.

【Claim 15】

The method as claimed in claim 12, further comprising the steps of supplying other reaction gas different from the reaction gas to surroundings of the ultra-fine particles flowing from the nozzle to the collecting means, producing a large number of other ultra-fine particles by allowing the other reaction gas to react thermochemically by providing the other reaction gas with heat energy, and coating the ultra-fine particles with the other ultra-fine particles.

【Claim 16】

A method for manufacturing ultra-fine particles using corona discharge, comprising steps of:

generating corona discharge by allowing a first power supplying means to apply a first high voltage to a first nozzle;

generating corona discharge by allowing a second power supplying means to apply a second high voltage to a second nozzle positioned downstream of the first nozzle;

injecting first reaction gas into a corona discharge region of the first nozzle by allowing a first reaction gas supplying means to supply the first reaction gas to the first nozzle;

producing a large number of first ultra-fine particles by injecting the first reaction gas into a corona discharge region of the first nozzle;

mixing the first ultra-fine particles and second reaction gas and supplying them to the second nozzle by a second reaction gas supplying means;

injecting mixed gas of the ultra-fine particles and the second reaction gas into a corona discharge region of the second nozzle and coating the first ultra-fine particles with a large number of second ultra-fine particles produced from the second reaction gas; and

collecting the first ultra-fine particles coated with the second ultra-fine particles by a collecting means.

【Claim 17】

The method as claimed in claim 16, further comprising the step of forming a gas curtain of sheath gas in order to lead flow of the ultra-fine particles between the second nozzle and the collecting means.

【Claim 18】

The method as claimed in claim 16, wherein the first and second high voltages are applied in the form of a pulse.